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MEMORANDUM FOR PRS (In-House Publication)

FROM: PROI (STINFO) 01 Nov 2002

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2002-261**
C.T. Liu (PRSM) et al., "Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material" (abstract only)

9th Int'l Conf. on the Mechanical Behavior of Materials **(Statement A)**
(Geneva, Switzerland, 25-29 May 2003) (Deadline: 22 Nov 02)

Investigating the Effects of Confining Pressure on Cumulative Damage and the Constitutive Behavior of a Particulate Composite Material

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It is well known that, on the microscopic scale, a highly filled polymeric material can be considered a nonhomogeneous material. When this material is strained, depending on the magnitude of local stress and local strength, damage may be developed in the material. The damage developed in the material may be in the form of microvoids or microcracks in the binder or in the form of dewetting between the binder and the filler particle. The developed damage will not be confined to a specific location, rather it will diffuse into a relatively large area or zone. The growth of the damage in the material may occur by material tearing or by successive nucleation and coalescence of the microvoids.

Throughout the loading history, the progressive development and interaction of various damage modes change the state of the material and the response of the structures. In addition to the microdamage, large cracks can also develop in the material either during the manufacturing processes or by service loads. Therefore, to effectively use the material in structural applications one needs to understand the damage initiation and evolution processes, the effects of damage and crack development on the material's response, and the remaining strength and life of the structures.

In past years, a considerable amount of effort was spent in obtaining a fundamental understanding of the effects of strain rate on damage processes and the constitutive behavior in highly filled polymeric materials at ambient pressure. In this study, the effects of confining pressure on damage processes and the constitutive behavior of a particulate composite material, containing hard particles embedded in a rubbery matrix, were investigated. A series of constant strain rate tests were conducted at three different displacement rates, 5.08 cm./min., 127 cm./min., and 508 cm./min., under 6.97 MPa confining pressure. A linear cumulative theory was used to determine the cumulative damage as a function of time under different loading conditions. The experimental data were analyzed to determine the relationship between the cumulative damage and the constitutive behavior of the material. The results of the analyses were discussed.